Replica symmetry breaking : how to generalize Parisi's ansatz ?

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In mean field spin glass models such as the Sherrington-Kirkpatrick model, it has been known for more than 40 years that overlaps fluctutate even in the thermodynamic limit [1,2]. The replica symmetry breaking (RSB) proposed by Parisi leads to precise and universal predictions of the statistical properties of these overlaps [2] . The random energy model [3] is probably the simplest model for which these predictions can be verified [4] . In this talk, I will present simple variants of the random energy model for which overlaps obey different statistics. Possible generalizations of Parisi's ansatz to recover these statistics will be discussed [5].

[1] G. Parisi, Infinite number of order parameters for spin-glasses, Phys. Rev. Lett. 43 (1979), p. 1754-1756.

[2] M. Mézard, G. Parisi, N. Sourlas, G. Toulouse, M. Virasoro, "Replica symmetry breaking and the nature of the spin glass phase", J. Phys. 45 (1984), no. 5, p. 843-854.

[3] B. Derrida, "Random-energy model : Limit of a family of disordered models", Phys Rev. Lett. 45 (1980), no.2, p.79-82.

[4] B. Derrida, G. Toulouse, "Sample to sample fluctuations in the random energy model", Journal de Physique Lettres 46 (1985), no. 6, p. 223-228.

[5] B. Derrida, P. Mottishaw, "Generalizations of Parisi's replica symmetry breaking and overlaps in random energy models" preprint 2024